

## Description

## Electromagnetic switching device

5 The present invention relates to an electromagnetic switching device, in particular a contactor, having an electromagnetic drive apparatus and having at least one electrical contact, which can be moved from a disconnected position to a bridging position by the  
10 electromagnetic drive apparatus when a pull-in current is applied to the electromagnetic drive apparatus, with the contact being closed in the bridging position and being open in the disconnected position,

15 Switching devices such as these are generally known. Merely by way of example, reference is made to DE 199 44 462 C1, EP 0 313 954 A1 and WO 01/24213 A1.

In order to ensure that electrical systems are not live  
20 while work is being carried out on or in these systems, main switches and switching devices with disconnector characteristics are specified. On the one hand, these must reliably signal, either by means of a visible disconnection gap or by an indication which reliably  
25 indicates the switching state of the device, the disconnection of the system from the supply. In particular, however, they must allow blocking which reliably prevents accidental connection. Furthermore, the switching point must reliably withstand an  
30 increased voltage. Furthermore, predetermined creepage currents must not be exceeded.

Devices of this type are described, for example, in IEC 60947-2 and IEC 60947-3. These Standards are  
35 implemented in electrical devices such as

- 1a -

disconnectors, load disconnectors, safety load disconnectors and circuit breakers with a disconnection function, and similar devices.

Electromagnetic switching devices such as contactors do not comply with these requirements. This is because they can generally be operated exclusively electromagnetically. Thus, in general, they can neither  
5 be operated mechanically nor can they be mechanically blocked. Two separate switching devices are therefore required to satisfy both the electromagnetic switching function and the mechanical disconnection function in the prior art.

10

The object of the present invention is to develop an electromagnetic switching device of the generic type further such that it also satisfies the disconnector characteristics in accordance with IEC 60947-2 and 3.

15

The object is achieved in that the contact can be mechanically blocked in the disconnected position by means of a locking element which can be connected to the switching device and can be blocked in the  
20 disconnected position when the switching device is completely installed, so that the contact is locked in the disconnected position even when the pull-in current is applied to the electromagnetic drive apparatus.

25 If the contact can be blocked in a locking element holder by the insertion of the locking element, the switching device has a particularly simple physical design. The locking element holder may in this case alternatively be open on both sides or on only one  
30 side.

If the locking element is held captive in the switching device, no separate element is required for blocking the contact. Furthermore, in this case, the locking  
35 element may be matched to the switching device, in particular to any locking element holder. Tolerances are therefore known in advance, and can be minimized.

- 2a -

If the switching device has an additional switch which can be connected in a circuit via which the pull-in current can be applied to the electromagnetic drive apparatus,

- 3 -

a power supply for the electromagnetic drive apparatus can be interrupted at the switching device.

5 If the additional switch is arranged and designed such that it is opened when the contact is mechanically blocked, it is not possible for opening of the coil circuit to be accidentally prevented.

10 In the prior art, the contact is generally in practice operated via a contact link support. In addition, the contact link support is often externally accessible, for example in order to fit an auxiliary switch. Furthermore, it is also possible for an electromagnetic switching device to be used for the purposes of a so-called reversing combination, that is to say together  
15 with a second switching device and a so-called reversing assembly. In reversing combinations such as these, the connection of one of the switching devices blocks the connection of the other switching device.

20 If the contact link support is externally accessible, it is possible to subdivide the switching device into a basic appliance and an additional appliance. In this case, the contact (and the contact link support as well) is arranged in the basic appliance and the  
25 locking element is connected to the additional appliance, at least when the contact is mechanically blocked in the disconnected position. The additional appliance is, of course, connected to the basic  
30 appliance in this case.

The connection between the additional appliance and the basic appliance may alternatively be detachable or non-detachable. At least when the contact is mechanically  
35 blocked in the disconnected position, the additional appliance should, however, be connected non-detachably to the basic appliance.

- 3a -

The connection between the basic appliance and the additional appliance is particularly simple if the additional appliance is latched to the basic appliance.

- 4 -

Depending on the configuration of the basic appliance, the additional appliance may be adjacent to the basic appliance on an appliance side which runs parallel or at right angles to a movement direction. In principle, the additional contact may be arranged as required. However, it is preferably arranged in the additional appliance.

If the switching device can be connected to an auxiliary switch housing in which an auxiliary switch is arranged which can be operated by the contact link support together with the contact, the switching device can be used more flexibly. The auxiliary switch is in this case preferably connected to the contact link support without any play. However, alternatively, the connection may be direct or indirect.

Further advantages and details will become evident from the following description of exemplary embodiments in conjunction with the drawings in which, illustrated in outline form:

Figure 1	shows a section through an electromagnetic switching device,
25 Figures 2 and 3	show modifications of Figure 1,
Figure 4	shows a section through a further electromagnetic switching device,
Figure 5	shows, schematically, a further electromagnetic switching device,
30 Figure 6	shows a detail from Figure 5,
Figures 7 to 9	show three views of the electromagnetic switching device shown in Figure 5, from the side, from the front and from above,
35 Figure 10	shows a section through the electromagnetic switching device shown in Figure 5, along a line X-X in Figure 8,

- 4a -

Figures 11 to 13, show three further views of the electromagnetic switching device shown in Figure 5, and



- 5 -

Figure 14 shows a section through the electromagnetic switching device shown in Figure 5, along a line XIV-XIV in Figure 12.

5

Figures 1 and 2 show a basic appliance 1 of an electromagnetic switching device in the form of a contactor, by way of example. The contactor has, inter alia, an electromagnetic drive apparatus 2, an armature 3, a contact link support 4 and, generally two or more, electrical contacts 5. For the sake of clarity, only one contact 5 is in this case illustrated in Figures 1 and 2. Each contact 5 generally comprises two stationary contact points 5' and one moving contact link 5''.

The electromagnetic drive apparatus 2 has a coil 2' and a coil core 2''. A pull-in current I can be applied to the coil 2' via a drive unit 6. In this case, the armature 3 is pulled in, thus moving the contact link support 4, and, with it, the contact link 5'' to a bridging position in which the contact 5 is closed. This state is illustrated in Figure 1.

When, on the other hand, no pull-in current I is applied to the coil 2'', the contact link support 4 and, with it, the contact link 5'' are moved by means of a return spring to a disconnected position, in which the contact 5 is open. This position is illustrated in Figure 2. The return spring is not illustrated in this case, for the sake of clarity.

During the movement from the disconnected position to the bridging position, and vice versa, the contact link support 4 is moved in a movement direction x. As can be seen from Figures 1 and 2, an additional appliance 7 is adjacent to the basic appliance 1. The additional

- 5a -

appliance' 7 is in this case adjacent to the basic appliance 1 on an appliance side which runs at right angles to the movement direction x.

- 6 -

The additional appliance 7 is likewise a component of the electromagnetic switching device, and is connected, for example latched, to the basic appliance 1. The additional appliance 7 has an extension 8 for the contact link support 4. The extension 8 is connected to the contact link support 4 - preferably without any play - so that the extension 8 is positively guided by the contact link support 4.

The additional appliance 7 has a locking element holder 9 which is continuous, that is to say it is open on both sides, and the extension 8 has a corresponding recess 10. When the contact link support 4 - and with it the contact 5 - is in the disconnected position, a locking element 11 can thus, as is shown in Figure 2, be guided manually through the locking element holder 9 - in this case, for example, the shackle 11 of a padlock 12. The locking element 11 is thus connected to the additional appliance 7 (and to the switching device), such that it is blocked in the disconnected position of the contact link support 4, by operation of a blocking element 13, in this case the closing element 13 of the padlock 12. When the locking element 11 is in the locking element holder 9, the extension 8 and, with it, the contact link support 4 and the contact 5 as well are mechanically blocked in the disconnected position. These elements 4, 5, 8 are thus locked in the disconnected position even when the pull-in current I is applied to the electromagnetic drive apparatus 2. As can be seen, the locking element 11 can in this case be inserted into the locking element holder 9 when the switching device is completely installed.

It is possible for the connection of the additional

- 6a -

appliance 7 to the basic appliance 1 to be detachable. However, it is preferably non-detachable, at least when the contact 5 is mechanically blocked in the disconnected position. Generally, it is even  
5 advantageous for the additional appliance 7 to be permanently and non-detachably connected to the basic appliance 1.

- 7 -

As can be seen from Figures 1 and 2, the switching device has an additional switch 14, which is arranged in the additional appliance 7. As can be seen from Figures 1 and 2, the additional switch 14 is connected in a circuit via which the pull-in current I can be applied to the electromagnetic drive apparatus 2. As can also be seen, it is arranged and designed in such a manner that it interrupts the circuit when the locking element 11 is inserted into the locking element holder 9, that is to say when the contact 5 is mechanically blocked. It is therefore impossible to accidentally connect the electromagnetic drive apparatus 2 when the contact link support 4 is blocked. This therefore avoids any possible damage resulting from a high current load on the coil 2' lasting for an excessively long time.

The embodiments shown in Figures 3 and 4 correspond essentially to the embodiment shown in Figures 1 and 2. As can be seen from Figure 3, however, an auxiliary switch housing 15 is fitted to the additional appliance 7 on a side opposite the basic appliance 1, and is connected to the additional appliance 7. By way of example, the auxiliary switch housing 15 may be latched to the additional appliance 7. An auxiliary switch 16 is arranged in the auxiliary switch housing 15. The auxiliary switch 16 is operated by the contact link support 4 together with the contact 5.

Owing to the subdivision of the switching device into the basic appliance 1 and the additional appliance 7, the auxiliary switch 16 can be operated by the contact link support 4 only via the extension 8, and thus indirectly. However, direct operation would also be possible with a corresponding integral configuration of the switching device. In any case, however, the

- 7a -

auxiliary switch 16 should be operable by the contact link support 4 without any play.

5 In the embodiment shown in Figure 4 - and in contrast to Figures 1 and 3 - the locking element holder 9 is open on only one side. Furthermore, the locking element 11 is permanently connected to the additional appliance 7 in the embodiment shown in Figure 4. For this purpose, the locking element 11 and the locking element

holder 9 have interacting holding and latching elements 17, 18, by means of which the locking element 11 is held captive in the additional appliance 7. As can be seen from Figure 4, one of the holding and latching elements 17, 18 corresponds to an operating member for the additional switch 14. The operating member for the additional switch 14 could, however, also be a separate element.

10 In the embodiment shown in Figures 5 to 14 as well, the electromagnetic switching device comprises a basic appliance 1 and an additional appliance 7. The design of the basic appliance 1 is in this case similar to that of the basic appliance 1 described above in  
15 Figures 1 to 4. All that need additionally be mentioned is that, in the case of the basic appliance 1 shown in Figures 5 to 14 - see in particular Figures 5 and 6 - an operating element 19 is arranged at the side on the contact link support 4. The expression "at the side" in  
20 this case relates to the movement direction x of the contact link support 4. The operating element 19 is rigidly connected to the contact link support 4. Blocking of the operating element 19 thus also blocks the contact link support 4 and the contact 5.

25 The basic appliance 1 illustrated in Figures 5 to 14 is known as such from so-called reversing circuits. In reversing circuits, two switching devices are arranged alongside one another. The second switching device is  
30 in this case indicated only by dashed lines in Figure 5. Each of the contact link supports 4 of the two switching devices has one of the operating elements 19 mentioned above. These interact with a blocking circuit 20, which is likewise known per se. The locking element  
35 11 is in this case arranged in the captive form in the blocking circuit 20.

- 8a -

When the left-hand contactor in the circuit according to the prior art shown in Figure 5 is, by way of example connected, the locking element 11 is deflected in such a way that it prevents connection of the right-hand contactor. Connection of the left-hand contactor is likewise and conversely prevented when the right-hand contactor is connected.



The method of operation described above is described in detail in EP 0 313 954 A1 as well as in WO 01/24213 A1. Reference is therefore additionally made to the these documents.

5

The known reversing circuits use two switching devices together with a blocking circuit 20. Each of the switching devices is in this case exclusively electromagnetically operable.

10

In the present invention, one of the two switching devices and the blocking circuit 20 are replaced by an additional appliance 7. The additional appliance 7 is thus fitted to the basic appliance 1, at the side. In this case as well, the connection between the additional appliance 7 and the basic appliance 1 may once again be a latching connection. The connection is preferably non-detachable, in particular when the contact 5 is blocked in the disconnected position.

20

As can be seen from Figures 7 to 10, the additional appliance 7 has a movement element 21. The movement element 21 is connected to the additional appliance 7, and is held captive in the additional appliance 7.

25

When the movement element 21 is moved in a blocking direction y, the locking element 11 is deflected such that it blocks the operating element 19, and thus also the contact link support 4 and the contact 5. In this case, of course, the blocking takes place with the contact 5 in the disconnected position. The movement element 21 can then - see Figures 11 to 14 - be blocked and thus secured by means, for example, of the padlock 12.

35

In this embodiment as well, as shown in Figures 5 to

- 9a -

14, the contact 5 can thus be mechanically blocked in the disconnected position.

In this embodiment as well, as shown in Figures 5 to 14  
5 - see in particular Figures 10 and 14 - an additional switch 14 is arranged in the additional appliance 7. This once again means

- 10 -

that mechanical blocking of the contact 5 results in positive and automatic interruption of the circuit via which the pull-in current  $I$  is applied to the coil 2' of the electromagnetic drive apparatus 2.

5

The refinement of the electromagnetic switching device according to the invention thus allows disconnector characteristics to be added to the electromagnetic switching device in a simple manner.